## ABSTRACT

The present invention provides a multicylinder homogeneous charge, compression ignition (HCCI) type engine, also known as a premixed charge compression ignition (PCCI) engine, with a control system designed to maintain stable, efficient, low emission HCCI combustion during engine transitions from one speed/load operating point to another speed/load operating point.

HCCI combustion control in the invention is obtained by adjusting specified "engine operating parameters" that influence the crank angle location of the combustion event (*viz.*, charge-air intake temperature, intake pressure (boost), charge-air oxygen concentration, engine cooling, and engine compression ratio), in coordination with adjustments in fuel quantity, by the following preferred method: (1) determining an existing "combustion parameter" value such as the maximum rate of pressure rise (MRPR), for each cycle of each cylinder, (2) adjusting an engine operating parameter of the engine to effect a change in said combustion parameter value, (3) thereafter adjusting an engine "control parameter" (e.g., commanded fuel quantity) to each cylinder, responsive to the effect of the adjusted engine operating condition, to maintain a desired target for the combustion parameter value, and (4) individually adjusting cooling, heating and/or fuel command to individual "outlier" (deviating) cylinders, to achieve uniform combustion.

Preferred control strategies to maximize HCCI combustion stability are also set forth, such as averaging sensed combustion parameter values and/or ignoring combustion parameter values within a specified dead band region so as to ignore cycle-to-cycle random variations of the combustion parameter values at stable HCCI operating points. Additional methods to minimize such engine combustion variability include increasing intake pressure (boost) and controlling

combustion chamber cooling, and are additionally described.